POHAKULOA PROPAGATION PROJECT: A CONTINUING SUCCESS STORY

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INTRODUCTION

In the latter part of the 18th century, the population of Nene, (Branta sandvicensis) was estimated at 25,000. In 1902, Henshaw predicted that "the time will inevitably come, and that soon, when this goose will need protection from sportsmen (and introduced predators) to save it from its otherwise inevitable fate of extermination." The Board of Agriculture and Forestry of the Territory of Hawaii operated a restoration project on O'ahu from 1927 to 1935. Nene were distributed to various interested people at the close of the project. By 1950, only one of these birds, a gander, was still alive and accounted for. The present Nene Restoration Project was started in Pohakuloa, Hawai'i, in 1949, with wildlife staff personnel in charge of the flock. At that time the world population was estimated to be approximately 50 Nene. Thirty of the 50 were estimated to be free flying in the fields; 20 were in captive flocks in three different locations. The captive flocks carried the same blood lines. The original two pairs at Pohakuloa were obtained on a breeding loan from Mr. Herbert Shipman, a cattle rancher from 'Ola'a, Hawai'i. Because the Shipman flock was the only one available, it was very likely that they were of an inbred line.

Captive Rearing

The inbreeding continued in the Project with poor results. Our records show that a high percentage of the inbred ganders were sterile. Embryos were of weak vitality and a high percentage died in the shell. Between 1953 and 1962 eight Nene were obtained from the fields. They included captured adults, young goslings, and a stray egg. Since they were not all taken from the same geographical area it is assumed that they were not too closely related. With this infusion of wild stock from the fields, the fertility and hatchability greatly improved in the Project (Table 1). The percent fertility of all eggs laid by Shipman strain geese was 54.5%; fertility of eggs laid by geese of different ages ranged from a low of 7.4% to a high of 75%. The percent fertility of all eggs laid by Wild strain geese was 76.7%; fertility of eggs laid by geese of different ages ranged from a low of 41.4% to a high of 100.0% (Table 2).

Management Techniques

The first clutch of eggs were removed from each goose at the completion of the clutch. This encouraged the goose to produce a second clutch of eggs during the breeding season.

Several methods of incubation have been tried in the Project. The use of setting Muscovy ducks, Silky bantam chickens, and mechanical incubators were tried. Ducks and bantams proved satisfactory as incubators; however, since the Nene laying season is between November and March, we had difficulty finding enough available setting hens and ducks. Fall and winter are, of course, the normal times for domestic fowl to go into molt. We have not had a high degree of success with mechanical incubators (Table 3).

Our best results have been to permit the goose to incubate her eggs. When the goslings of the first clutch begin to pip, the eggs are taken away from the goose and placed in an incubator-hatcher. The nest of the goose is broken up, and we have been successful in having Nene lay second clutches of eggs during the season. Three to five eggs are laid with an average clutch size of four. We have had a few six-egg clutches, and one successful hatching of six goslings out of six eggs. The incubation period for Nene eggs is 30 to 32 days.

The goslings of the first clutches are hand-reared. The parent pair are permitted to raise the goslings of the second clutch.

The diet of the Nene goslings consists primarily of greens, commercial poultry feeds, and vitamin/mineral supplements. The favorite choice of greens is Sow thistle (Sonchus oleraceus), and we go out of our way to collect it in the lower elevations for the flock. In Pohakuloa a rye grain-barley cross, Zetra petra, is planted during the fall and winter months when frost kills the local vegetation. This has proven to be very acceptable to the Nene; however, they will also graze on any green grass, including kikuyu (Pennisetum clandestinum), chickweed (Stellaria media), and varieties of clover.

We keep accurate pedigree records of all Nene bred, raised, or kept at Pohakuloa. Pairs of Nene are mated as long as they are productive and compatible. We have pairs of producing Nene in the breeding flock that are 14 years of age. Most Nene breed in their second year, but we had one goose that produced young her first year. Mated pairs have been successfully broken up, when the need arises, and mated to other mates.

The strain of "hairy down" goslings has been successfully bred out of the flock during the past three years.

At six weeks of age, the goslings are cloacally sexed and banded with numbered aluminum U. S. Fish and Wildlife Service bands. Goslings are capable of flight at 10 weeks, so their primaries are clipped while they are in the pens. Prior to release,

each Nene is banded with colored plastic leg bands. The order of the color bands is a "color band combination" for a specific individual, and no two Nene are banded alike. As many as three color bands have been placed on each leg of an individual Nene. The aluminum U. S. Fish and Wildlife Service bands are removed before release, and our records contain the given serial number as well as the color band combination. Biological studies in the field are facilitated by this method of record keeping.

Goslings are taken out to the gentle-release pen in the fields between two and eight months of age. In years when we produce a large number of goslings, the young are sent out in groups of about the same age. In years when production is smaller, the goslings are held until the last broods are ready for flight, for a single yearly release.

The development of techniques for captive breeding and rearing Nene for successful release has been a challenge to all of us associated with the Project. Between 1949 and 1978, we have been successful in raising 1699 Nene at Pohakuloa (Table 4). 1225 have been released on the Island of Hawai'i; 268 have been released on the Island of Maui in Haleakala Crater (198 Nene were shipped to Hawai'i from the Wildlife Trust in England, and those birds, as well as seven Nene from a private breeder in Connecticut, have been released on Maui).

Now, as the Endangered Species Propagation Project, we continue our work with Nene, Koloa (Anas wyvilliana), Laysan teal (Anas laysanensis), and the 'Alala (Corvus tropicus).

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TABLE 1. Summary of production at Pōhakuloa from 1953-1954 through the 1971-1972 breeding season.

Season	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963
No. Breeding Pairs	6	4	5	6	6	15	14	15	16	16
No. Producing	4	4	5	6	6	15	14	15	16	16
First Clutch	4	4	5	6	6	15	14	15	16	16
Second Clutch	0	1	1	2	5	12	13	14	14	16
Third Clutch	0	0	1	2	4	6	8	10	9	13
Fourth Clutch	0	0	0	1	2	3	0	0	2	1
Total Eggs	14	16	27	46	76	118	149	174	181	204
Eggs per Clutch	3.5	3.2	3.8	4.1	4.4	3.3	4.3	4.4	4.4	4.4
Eggs per Goose	3.5	4.0	5.4	7.7	12.6	7.9	10.6	11.6	11.3	12.7
No. Fertile, LG*	6	4	18	22	15	28	56	97	87	130
No. Fertile, DG**	0	1	0	0	1	4	5	18	18	17
No. Infertile	8	10	8	16	47	76	86	49	68	50
No. Damaged[1]	0	1	1	8	13	10	2	10	8	7
Percent Eggs with Fertile, LG	42.8	35.0	66.7	47.8	19.7	23.7	37.5	55.7	48.1	63.7
Percent Eggs Fertile	42.8	31.2	61.7	47.8	21.1	27.1	40.9	66.2	58.1	72.7
No. Hatched	4	4	8	14	8	11	27	40	52	65
Percent Hatchability[2]	66.8	100.0	44.5	63.7	53.3	39.2	48.2	41.2	59.8	50.0
Mortality[3]	0	0	0	2	4	1	8	7	6	5
Percent Mortality	0	0	0	14.3	50.0	9.1	29.6	17.5	11.5	7.8
Goslings per Goose[4]	1.0	1.0	1.6	2.3	0.7	0.7	1.9	2.7	3.2	4.1

TABLE 1--Continued.

Season	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972
No. Breeding Pairs	17	17	20	24	30	40	30	29	26
No. Producing	16	16	20	23	27	38	30	29	21
First Clutch	16	16	20	23	27	38	30	29	21
Second Clutch	15	15	16	19	18	26	13	25	18
Third Clutch	13	8	11	7	2	0	1	5	2
Fourth Clutch	1	0	0	0	0	0	0	0	0
Total Eggs	202	176	197	208	196	259	180	260	185
Eggs per Clutch	4.5	4.5	4.2	4.2	4.2	4.0	4.1	4.5	4.5
Eggs per Goose	12.6	11.0	9.9	9.1	7.3	6.8	6.0	8.6	8.9
No. Fertile, LG*	106	121	138	143	151	200	145	191	139
No. Fertile, DG**	28	22	18	10	6	7	12	28	4
No. Infertile	56	26	32	43	26	36	19	29	29
No. Damaged[1]	11	7	9	12	13	16	10	12	13
Percent Eggs with Fertile, LG	52.7	68.7	70.1	68.7	77.0	77.2	80.6	73.5	75.0
Percent Eggs Fertile	66.3	81.3	79.2	73.7	80.2	80.0	88.3	84.2	77.0
No. Hatched	47	50	81	93	121	176	122	145	111
Percent Hatchability[2]	44.3	41.3	58.7	65.0	80.1	88.0	78.7	66.2	77.6
Mortality[3]	5	6	11	1	5	13	8	13	7
Percent Mortality	10.6	12.0	13.6	1.1	4.1	7.4	6.5	8.9	5.0
Goslings per Goose[4]	2.9	3.1	4.1	4.0	4.5	4.6	3.8	5.0	4.0

[1] These are eggs broken in the nest; soft-shelled; abnormally small, etc. Fertility undetermined.

[2] Percent of eggs with fertile, live germs that were successfully hatched.

[3] Only post-hatch mortality (occurring within the first two weeks) is included here.

[4] This represents production per goose of goslings successfully hatched.

**LG means live germ at 10 days of incubation.

**DG means dead germ at 10 days of incubation.

TABLE 2. Fertility of eggs in relation to the age of geese.

PART A: Shipman Strain Geese (14 Geese)

Age	2	3	4	5	6	7	8	9	10	11	12
No. of Geese	8	12	10	10	9	9	8	6	6	6	5
No. of Eggs	68	111	119	119	118	110	94	70	60	59	46
No. Fertile	5	30	65	62	79	66	56	56	43	43	29
Percent Fertile	7.4	27.0	54.7	52.1	67.0	60.9	59.6	71.4	71.7	72.8	63.1

PART B: Wild Strain Geese (29 Geese)

Age	2	3	4	5	6	7	8
No. of Geese	27	15	9	7	4	3	1
No. of Eggs	212	143	83	66	29	17	4
No. Fertile	164	121	66	43	12	15	4
Percent Fertile	72.4	84.7	79.5	65.2	41.4	88.3	100.0

Table 3. Hatching success as related to method of incubation.

Method of Incubation	Muscovy Ducks[1]	Silky Bantam Hens[2]	Mechanical[3]	Nene[4]
Number of Eggs*	61	201	393	419
Number with Fertile, Live Germs	43	156	294	335
Number with Fertile, Dead Germs	1	16	43	10
Number Infertile	11	22	55	49
Number Damaged	6	7	1	22
Number Incubated Full-Term	43	156	294	335
Number Hatched	17	78	88	294
Percent Hatchability +	39.6%	50.0%	29.9%	88.0%

* All eggs are from first and second clutches.

[1] Ducks were used from 1957-58 through 1959-60.

[2] Hens were used from 1961-62 through 1964-65.

[3] Mechanical incubation was used from 1960-61 through 1966-67.

[4] Data for incubation by Nene is from 1958-59 through 1968-69.

Percent hatchability in terms of number hatched divided by the number incubated full term.

Note: Ducks were used to supplement Nene for incubating eggs during the early stages of the propagation program. The hatchability was comparatively poor because the geese were predominantly Shipman strain geese. These blood lines had been found to have low fertility and hatchability.

TABLE 4. Nēnē restoration project record (July 1, 1949 through June 30, 1977).

Nēnē Reared at Pōhakuloa			Nēnē Released Island of Hawai'i*					Nēnē Released Island of Maui				Total Nēnē Released
Year	Number	Year Released	Keauhou Sanctuary	Keauhou 2 Sanctuary	Kahuku Sanctuary	Kīpuka 'Āinahou Sanctuary	Total	From England	From Pōha-kuloa	Connec-ticut	Total	
1949-50	2											
1950-51	3											
1951-52	2											
1952-53	1											
1953-54	4											
1954-55	4											
1955-56	8											
1956-57	12											
1957-58	3											
1958-59	15											
1959-60	17	1960	20	-	-		20	-	-	-	-	20
1960-61	32	1961	11	20	-		31	-	-	-	-	31
1961-62	45	1962	-	35	-		35	30	5	-	35	70
1962-63	54	1963	-	42	-		42	19	5	5	29	71
1963-64	38	1964	-	-	-		-	20	8	-	28	28
1964-65	41	1965	30	19	-		49	24	8	2	34	83
1965-66	69	1966	-	-	-		-	-	25	-	25	25
1966-67	84	1967	-	-	75		75	-	-	-	-	75
1967-68	123	1968	-	-	85		85	-	20	-	20	105
1968-69	156	1969	-	33	122		155	50	22	-	72	227
1969-70	114	1970	106	-	-		106	55	-	-	55	161
1970-71	131	1971	94	-	-		94	-	-	-	-	94
1971-72	104	1972	2	35	-		37	-	44	-	44	81
1972-73	109	1973	13	-	-	61	74	-	50	-	50	124
1973-74	134	1974	-	-	-	123	123	-	-	-	-	123
1974-75	141	1975	-	-	-	135	135	-	-	-	-	135
1975-76	160	1976	-	164	-	-	164	-	34	-	34	198
1976-77	47	1977	-	-	-	-	-	-	48	-	48	48
Totals	1653		276	348	282	319	1225	198	269	7	474	1699

* All of the Nēnē released on Hawai'i were reared at Pōhakuloa.